QUARTERLY PROGRESS REPORT

Contract NAS8-30563

MAGNETOSPHERIC RESEARCH

December 1979 - February 1980

by

Richard H. Comfort

and

James L. Horwitz

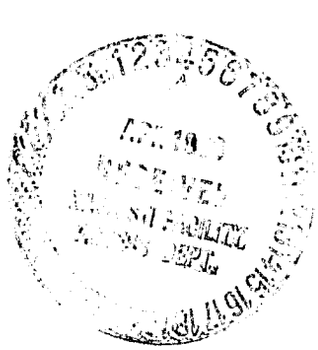
Prepared for

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

Submitted by

The University of Alabama in Huntsville
School of Science and Engineering
Huntsville, Alabama 35807

March 1980



SATALLITE DATA ANALYSIS

During this reporting period the paper presenting ATS-6 warm plasma observations (Ref. 1) appeared in the Journal of Geophysical Research (JGR). A second paper on ATS-6 observations of conical pitch angle distributions (Ref. 2) was accepted by JGR. A third on occurence frequencies of ion pitch angle distributions observed by ATS-6 is undergoing revision in the JGR review process. In addition, a paper on initial ISEE-1 thermal plasma observations has been accepted by Geophysical Research Letters (Ref. 4).

In the analysis of ISEE data, several interesting new features of pancake pitch angle distributions have been found. Probably most important is the discovery that pancake distributions occur far more frequently near the equator than at high latitudes; hence, the equatorial regions are the likely site of their creation. This and other features of the pancake distributions are presented in a paper, undergoing co-author review, to be submitted to JGR (Ref. 5).

Other activity has involved continuing development of computer routines for analyzing distribution functions from ISEE data. Routines for contouring the distribution functions in the spin plane have been completed. Routines to transform these contours to a magnetic-field-based coordinate system, $V_{||}$ and $V_{\perp}$, are almost complete. Efforts are also being made to fit these distributions with various analytic representations, for example, representing pancake distributions as a bi-Maxwellian, with $T_{\perp} > T_{||}$. An abstract (Ref. 6) on this work has been submitted for the Spring Meeting of the American Geophysical

Union in Toronto.

Further efforts have been directed toward automating the procedure for obtaining plasma parmeters (N, T, V) and spacecraft potential from the data. The successful comparison of spin curve data with curves predicted by the thin sheath or neutral planar approximation for cold plasmasphere data (Ref. 7) suggests that this approximation provides an adequate basis for such a procedure. Recent calculations by N. Singh (private communication) indicate that because of the limited aperture of the ISEE instrument, flux to the aperture is virtually independent of Debye length. So the thin sheath approximation should provide good results, insofar as sheath effects are concerned, for a much broader range of conditions than previously anticipated. On this basis a procedure for the parameter determination has been worked out. After testing with data, software development will begin. One possible problem area may be a spin modulation of the spacecraft potential, suggested by Mozer's group from the electric field experiment data.

Ion temperatures are presently being added to the density information in the number density comparision study (Ref. 8) and to the density and Mach number information in the study of ISEE spin data (Ref. 7). If electron temperatures cannot be obtained, they will be approximated by ion temperatures; this is probably adequate within a factor of two (Julian Johnson, private communication.) Spacecraft potential will also be determined to allow a complete analysis.

INSTRUMENT STUDIES AND DEVELOPMENT

Software development for analysis of future Differential Ion Flux (DIF) Probe Laboratory and space flight data has continued. The deflection curve analysis routine was modified to generalize its application. Also, noise fluctuations were added to a set of simulated Retarding Potential Analyzer (RPA) data to assess the accuracy of the RPA analysis routine.

For the DIF Probe being built for Spacelab 2, assistance was provided in the laboratory checkout of the instrument flight electronics. Manufacture of the head was completed when the deflection system was found to require modification. Several design modifications of the deflection system were analyzed by means of computer simulation of particle tratectories through the instrument. A new head is now being built with the redesigned deflection system.

Engine design for the proposed Solar Electric Propulsion Satellite (SEPS) were analyzed briefly. Contour plots of the magnetic field resulting from the dipole magnet of the engine were generated to help assess problems of contamination of scientific instrument payloads.

In addition, the following items were worked on or completed:

- Flanges for a new vacuum system were designed.
- A carriage for the new vacuum system is being designed.
- The RPA head for the Plasma Diagnostics Package was built, following design completion.
- Design of the electronics package for the Plasma Diagnostics Package is underway.

SOLAR TERRESTRIAL STUDIES

The second meeting of the Solar Terrestrial Observatory Science Study Group was held on February 20-22, 1980 in Boulder, Colorado. Approved and prospective NASA programs in the solar terrestrial area were reviewed; and substantial progress was made in formulating the scientific objectives identified at the first meeting. Further assignments have been given to group members for the interim. The next meeting will be held in Los Angeles on July 9-11, 1980. A revised membership list is attached, indicating those who attended the second meeting.

MEETINGS

Dr. Comfort attended the Fall Meeting of the American Geophysical Union in San Francisco, California, December 3-7, 1979, where he presented a paper comparing ISEE spin curves with those predicted by the thin sheath approximation (Ref.7). Although Dr. Horwitz was unable to attend, he was principal author and co-author of two papers which were presented at the meeting (Ref. 9 and Ref. 10).

CONSULTANTS

Dr. James L. Green, University of Iowa, visited on December 12-16, 1979 to discuss collaborative studies using low energy ion and wave observations made with instruments on the ISEE-1 Spacecraft. These studies should enhance our ability to make effective use of available data in activities under this contract.

REFERENCES

1. Horwitz, J. L. and C. R. Chappell, Observations of warm plasma in the dayside plasma trough at geosynchronous orbit, J. Geophys. Res., 84, 7075, 1979.

2. Horwitz, J. L., Conical distributions of low-energy ion fluxes at synchronous orbit, J. Geophys. Res., in press, 1980.

3. Comfort, R. H. and J. L. Horwitz, Low energy ion pitch angle distributions observed on the dayside at geosynchronous altitudes, submitted to J. Geophys. Res., 1979.

4. Baugher, C. R., C. R. Chappell, J. L. Horwitz, E. G. Shelley and D. T. Young, Initial thermal plasma observations from ISEE-1, accepted by Geophys. Res. Lett., 1980.

5. Horwitz, J. L., C. R. Baugher, C. R. Chappell, E. G. Shelley and D. T. Young, Pancake distributions of warm ions observed by ISEE-1, to be submitted to J. Geophys. Res., 1980.

6. Horwitz, J. L., G. O. Dennis, C. R. Baugher, C. R. Chappell, E. G. Shelley and D. T. Young, Analytic representations for thermal ion distribution functions observed by ISEE-1, submitted for presentation to the Spring Meeting of the American Geophysical Union, May 23-27, 1980, Toronto, Canada.

7. Comfort, R. H., C. R. Baugher, N. H. Stone, U. Samir, E. G. Shelley and D. T. Young, Angular distribution of ion fluxes around the ISEE-1 Spacecraft, EOS (abstract), 60, 929, 1979.

8. Comfort, R. H., C. R. Baugher, C. R. Chappell, W. K. Peterson, E. G. Shelley and R. R. Anderson, Comparison of density determinations from particle and wave experiments on ISEE-1, EOS (abstract), 60, 366, 1979.

9. Horwitz, J. L., C. R. Baugher, C. R. Chappell, E. G. Shelley and D. T. Young, Occurrence of pancake distributions in E $\leq$ 100eV ions observed with ISEE-1, EOS (abstract), 60, 929, 1979.

10. Baugher, C. R., C. R. Chappell, J. L. Horwitz, E. G. Shelley and D. T. Young, Occurrence of isotropic and field aligned distributions in low energy ions near the plasmapause, EOS (abstract), 60, 1979.

Richard H. Comfort
Assistant Research Professor

James L. Horwitz
Assistant Research Professor

SOLAR TERRESTRIAL OBSERVATORY SCIENCE STUDY GROUP

* Dr. Robert M. MacQueen
High Altitude Observatory
P. O. Box 3000
Boulder, Colorado 80307
(303) 494-5151, Ext. 76360

* Dr. John A. Eddy
High Altitude Observatory
P. O. Box 3000
Boulder, Colorado 80307
(303) 494-5151, Ext. 76332

* Dr. Richard C. Canfield
Center for Astrophysics & Space Science (C-011)
University of California, San Diego
La Jolla, California 92093
(714) 452-2507

* Dr. Marcia M. Neugebauer
Mail Code 183-401
Jet Propulsion Lab., Cal. Tech.
4800 Oak Grove Drive
Pasadena, California 91103
(213) 354-4110

Dr. Christopher T. Russell
Institute of Geophysics and
Planetary Physics
Univ. of California, Los Angeles
Los Angeles, California 90024
(213) 825-3188

Dr. William W. L. Taylor
Space Sciences Department
TRW Defense and Space Systems Group
One Space Park, R-1/1176
Redondo Beach, California 90278
(213) 536-2015

Dr. George A. Paulikas
Aerospace Corporation
El Segundo, California 90045
(213) 648-7076

* Dr. Andrew F. Nagy
Space Physics Research Laboratory
University of Michigan
Ann Arbor, Michigan 48109
(313) 764-6592

* Dr. Phillip B. Russell
SRI International
Menlo Park, California 94025
(415) 326-6200, Ext. 4672

* Dr. Crofton B. Farmer
Mail Code: 170-25
Planetary Science
Calif. Institute of Technology
Pasadena, California 91125
(213) 795-6811, Ext. 2970

* Dr. Marvin Geller
Rosenthiel School of Marine and
Atmospheric Science
University of Miami
Miami, Florida 33149
(305) 350-7566

* Dr. Bernhard Haurwitz
Department of Atmospheric Science
Colorado State University
Fort Collins, Colorado 80521
(303) 491-8541

* Dr. John F. Noxon
Aeronomy Laboratory
NOAA
Boulder, Colorado 80302
(303) 499-1000, Ext. 3366

* Dr. Leonard A. Fisk
Physics Department
University of New Hampshire
Durham, New Hampshire 03824
(603) 862-2752

* Dr. John T. Gosling
Group P-4
Los Alamos Scientific Laboratory
Los Alamos, New Mexico 87545
(505) 667-5389

NASA PARTICIPANTS

* Dr. Einar A. Tandberg-Hanssen
Space Sciences Lab., Code ES-51
NASA/MSFC
Huntsville, AL 35812
(205) 453-0027

* Dr. Charles R. Chappell
Space Sciences Lab., Code ES-53
NASA/MSFC
Huntsville, AL 35812
(205) 453-3036

Dr. William W. Vaughan
Atmospheric Sciences Division, Code ES-81
NASA/MSFC
Huntsville, AL 35812
(250) 453-3100

* Participants in the second meeting